Course: PHY U165, 2004
Instructor: Darien Wood

Darien Wood
Northeastern University

Homework 10

Due: Wednesday, March 24, 2004 08:00 AM EST

About this assignment

PHYU165 Homework #10, Hecht Ch. 18, resistor and RC circuits

---

1. [HechtCal2 18.MC.011.] In Fig. MC6, when a wire is clipped to points C and E, what happens?

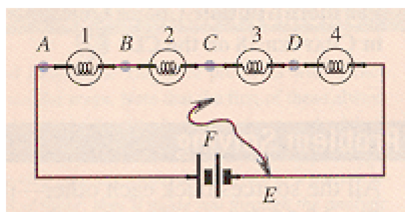

Figure MC6.

- The power dissipated by the circuit decreases.
- The power delivered by the battery remains unchanged.
- none of these
- The power dissipated by the circuit is halved.
- The power delivered by the battery increases. [0.5]

2. [HechtCal2 18.MC.018.] What is the current in any one of the 4-Ω resistors in the circuit of Fig. MC18?

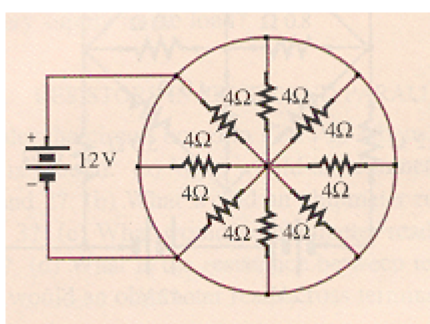

Figure MC18.

- 3 mA
- 0
- 1.2 A

- 12 A
- none of these [0.5]

3. [HechtCal2 18.P.059.] An electronic flash fires a blast of energy from a 804-μF capacitor into a xenon lamp. It recharges through a series resistor of 4.9 kΩ. How long will it take to recharge 63% of its maximum charge?

s

4. [HechtCal2 18.P.062.] A resistor is placed in series with an uncharged 2.1-μF capacitor, and a 16.0-V battery is put across the two. If the current that immediately flows around the circuit is measured to be 9 μA, determine the resistance.

[0.5] Ω

What is the time constant of the circuit?

[0.5] s

5. [HechtCal2 18.P.085.] The switch in the circuit of Fig. P85 is closed, and a steady state is established. What is the charge on the 3.0 μF capacitor (C)? (R = 6.0 Ω.)

μC

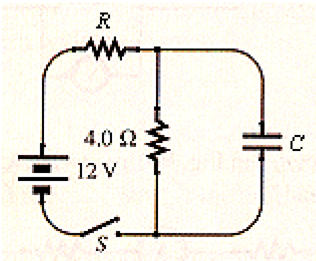

Figure P85

6. [HechtCal2 18.P.091.] Only switch S_1 closed in Fig. P91. (C = 3.5 μF and R = 23 Ω.)

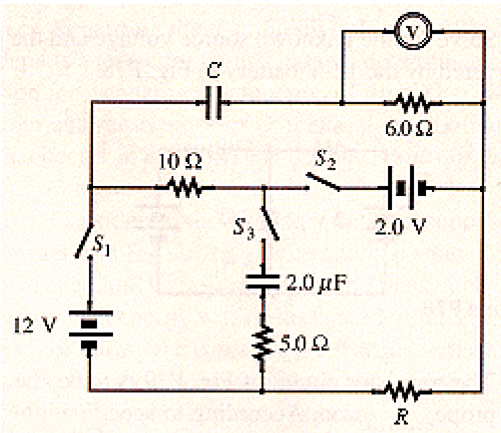

Figure P91

(a) What is the steady-state reading of the voltmeter?

[0.5] V

(b) What is the charge on the 3.5 μF capacitor?

[0.5] ________ μC

7. [HRW5 28.69P] A 3.25 MΩ resistor and a 1.00 μF capacitor are connected in series with an ideal battery of $\mathcal{E}$ = 3.00 V. At 1.00 s after the connection is made, what are the rates at which

(a) the charge of the capacitor is increasing,
[0.5] ________ C/s
(b) energy is being stored in the capacitor,
[0.5] ________ W
(c) thermal energy is appearing in the resistor, and
[0.5] ________ W
(d) energy is being delivered by the battery?
[0.5] ________ W

8. [HRW5 28.72P] A 0.9 μF capacitor with an initial stored energy of 0.48 J is discharged through a 1.0 MΩ resistor.

(a) What is the initial charge on the capacitor?
[0.25] ________ C
(b) What is the current through the resistor when the discharge starts?
[0.25] ________ A

(c) Determine V_C, the potential difference across the capacitor, and V_R, the potential difference across the resistor, as functions of time.

- ○ $V_C = V_R = \frac{q_0 R^2}{C} e^{-2t^2/(RC)^3}$
- ○ $V_C = V_R = \frac{q_0}{C} e^{-t/RC}$
- ○ $V_C = V_R = \frac{q_0 R}{C^2} e^{-t/RC}$
- ○ $V_C = V_R = \frac{q_0 R}{C} e^{-2t/RC}$ [0.25]

(d) Express the production rate of thermal energy in the resistor as a function of time.

- ○ $P = \frac{q_0 \sqrt{2 C U_C}}{(RC)^2} e^{-2t/RC}$
- ○ $P = \frac{q_0 \sqrt{2 C U_C}}{R^3 C^2} e^{-2t/RC}$

○ $P = \frac{q_0^2 R}{(RC)^2} e^{-2t/RC}$

○ $P = \frac{q_0 \sqrt{2CU_c}}{R^3 C^2} e^{-2t/(RC)^2}$ [0.25]

9. This question is related to laboratory Experiment #33, "R-C" Circuits".
A 6.0 V power supply (with negligible resistance) is connected in series with a 1.0 kΩ resistor, and is used to charge two capacitors: C_1=0.10 F, and $C_2$0.50 µF. At first the capacitors are discharged, connected in series, then charged from the supply+battery. In a second trial, the capacitors are discharged, then connected in parallel, and then charged from the battery+resistor. A meter measures the voltage across the resistor, V_R. Find the time for the V_R to drop to 0.9 V in each case:

(a) capacitors in series: t = [0.5] ______ s
(b) capacitors in parallel: t = [0.5] ______ s

10. Consider a battery of voltage *V* which charges a capacitor of capcitance *C* through a resistor of resistance *R*. Derive an expression for the work done by the battery in charging the capacitor. Careful: in the process there is both energy dissipated in the resistor and stored in the capacitor. [Hint: Find the power output of the battery as a function of time, and integrate it to find the work done.]
You should write out the derivation on paper and hand it in at the beginning of class on Wednesday. When you have completed the work, just write "I have finished the problem and will hand it in." in the box below.

Save Work without Grading

Submit for Grading

Return to Assignments Summary